A Look Back at the May 24 2012 Severe Wind Event over Western Wisconsin

Event Synopsis

On May 24 2012 severe weather struck western Wisconsin as storms developed along a powerful cold front and moved across the region resulting in widespread wind damage. Locations especially hard hit were from eastern Pepin and Dunn counties, up through Chippewa, Eau Claire, and Rusk counties. Numerous large trees were either uprooted or snapped off. Several structures also received damage as the storms moved through. Only one tornado was reported in Marathon County near Rib Mountain Wisconsin. The rest of the damage resulted from straight-lined winds of 70 to 85 mph. These wind speeds are just as high as an EF0/EF1 tornado. This is another example of how severe thunderstorms can be dangerous, and even life-threatening, so it is best to seek shelter in a sturdy structure away from windows until the storm has passed. The storm reports shown below identify wind damage from northeast Iowa up through southeast Minnesota and into northern Wisconsin (Fig 1).

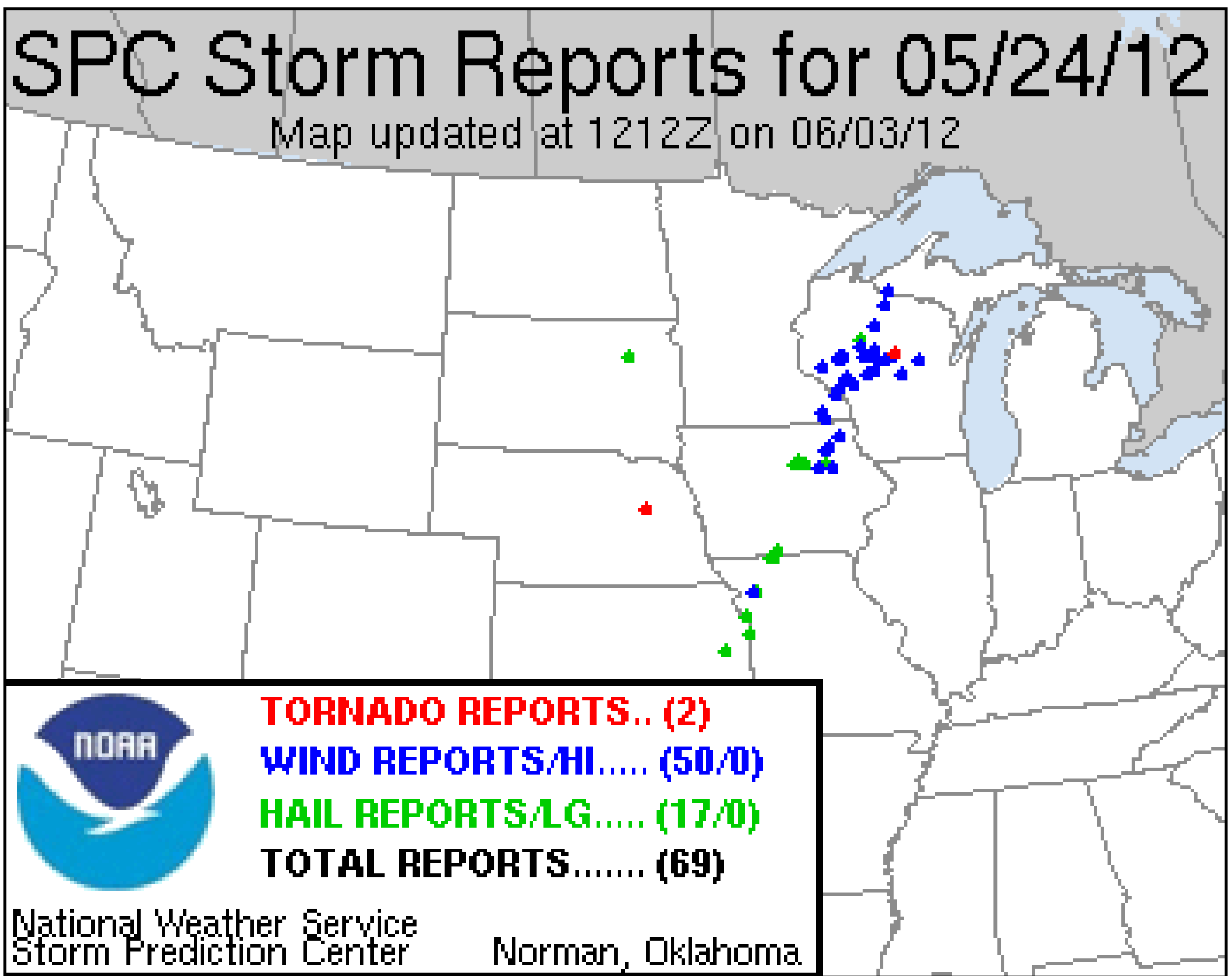

Figure 1: The image above shows the storm reports across the Upper Midwest from May 24 2012. In reference to the legend in the lower left, the blue dots depict the widespread wind damage in western Wisconsin.

There was evidence days in advance that the weather pattern would be favorable for severe weather. The Storm Prediction Center (SPC), which is based out of Norman Oklahoma, highlighted western Wisconsin as the favored region for severe weather in their Day 2 Outlook (not shown). On the day of the event, confidence increased and western Wisconsin was placed in a Moderate Risk area, with damaging wind as the primary threat (Fig 2). This is significant, because Moderate Risks are fairly rare in the Upper Mississippi River Valley region.

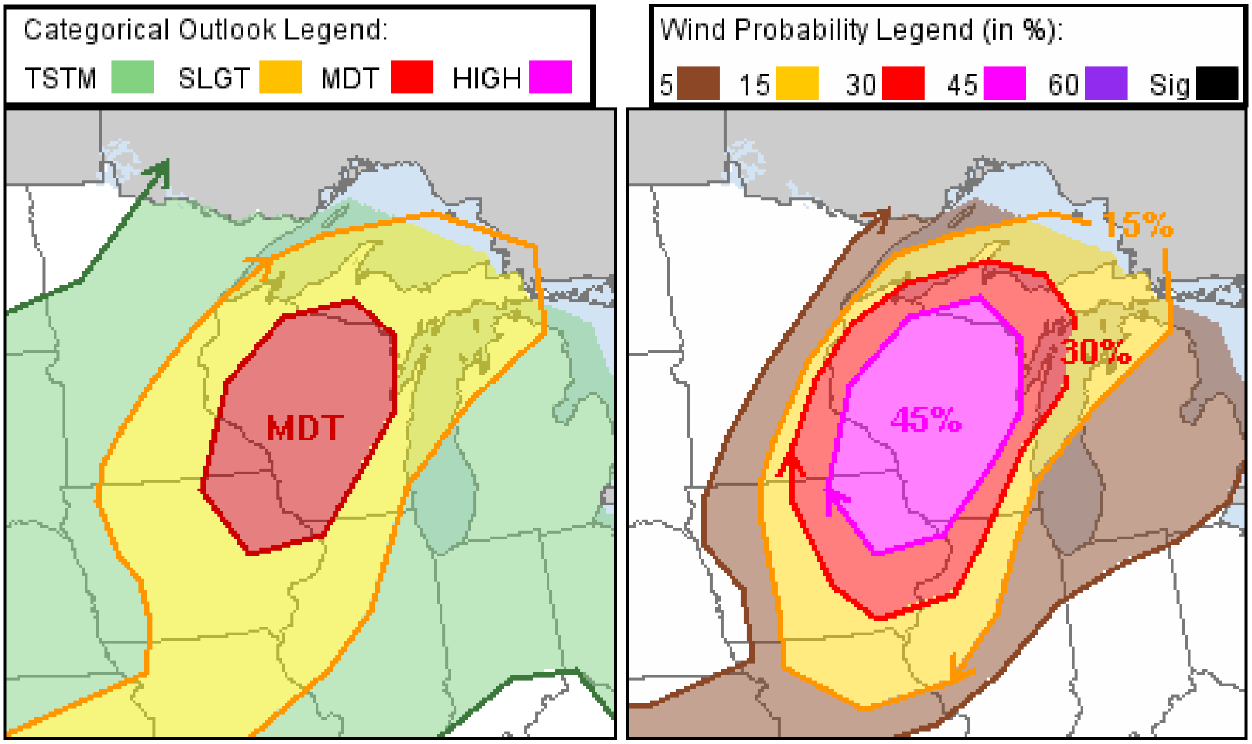

Figure 2: The left-hand image shows the Day 1 severe outlook. Western Wisconsin was in a moderate risk, which only happens a few times per year on average. The right-hand image shows the probability of severe wind. The pink 45% area means that there is a 45% chance that severe wind (58mph or greater) will occur within a 25 mile radius of any given location within that area.

Generally speaking, there are two main ingredients for severe weather. One is an unstable atmosphere with warm moist air at the surface. The other is wind shear, or different wind speeds and/or directions at different levels of the atmosphere. On this day both were in place across the region, but the wind shear was more impressive. At the surface ahead of the approaching cold front, temperatures were in the upper 80s and winds were out of the south at around 10 mph. However, just about a mile above the ground the winds were screaming from the southwest at 40 to 50 mph. More impressively, at 3.5 miles above the ground, the winds were southwest at 80 to 90 mph! Any thunderstorm that formed in this environment would have the potential to bring these strong winds down to the surface.

The storms developed in the early afternoon across eastern Minnesota, and quickly moved northeast into western Wisconsin. They intensified as they crossed the Mississippi River, and began to surge forward as they approached Eau Claire and Chippewa falls. This forward surge is referred to as "bowing out", and results from a strong, often damaging downdraft racing out at the leading edge of the storm. On this day, the storms did not extend very high up into the atmosphere, but they were still able to bring destructive winds down to the surface. The following radar images depict the severe weather as it moved over west central Wisconsin.

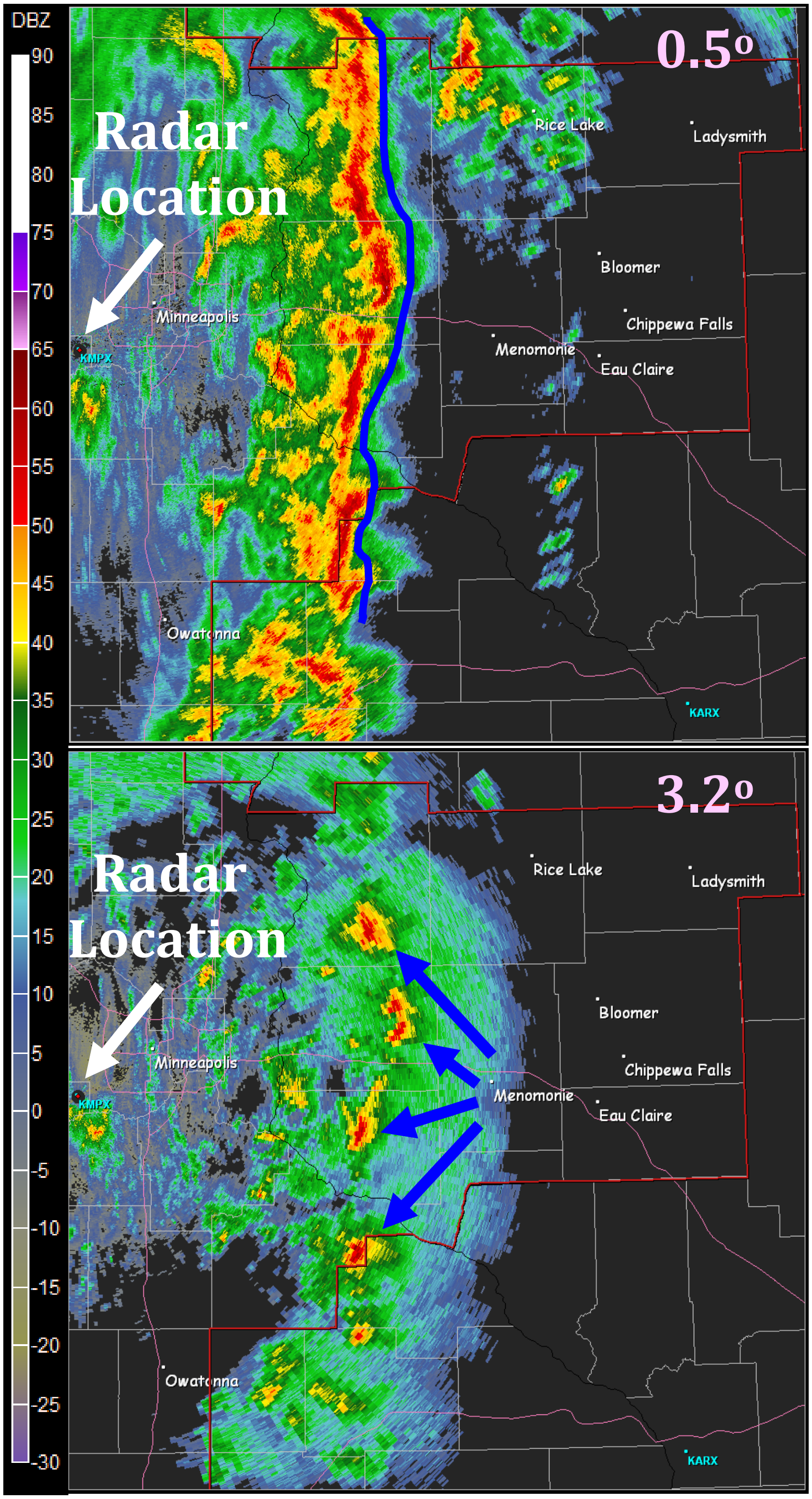

Figure 3: The 2-panel radar reflectivity image to the left is from May 24 2012 at 303pm. The radar location is identified by the white arrow. Both images are from the same time. The warmer colors in the reflectivity image (yellow, orange, red) suggest where the rain and small hail is located in the storm. The top image is reflectivity at 0.5º. This is the lowest scan our radar is capable of, and the radar beam at the location of the line of storms is about 4000ft above the ground. At this level one can clearly see the line of thunderstorms (blue dashed line).

The bottom image is reflectivity at 3.2º, which is roughly 20,000ft above ground level. The higher reflectivity as shown by the red colors easily identifies the cores of the individual storms (blue arrows). Recall from earlier the strong winds that were present at these different levels of the atmosphere.

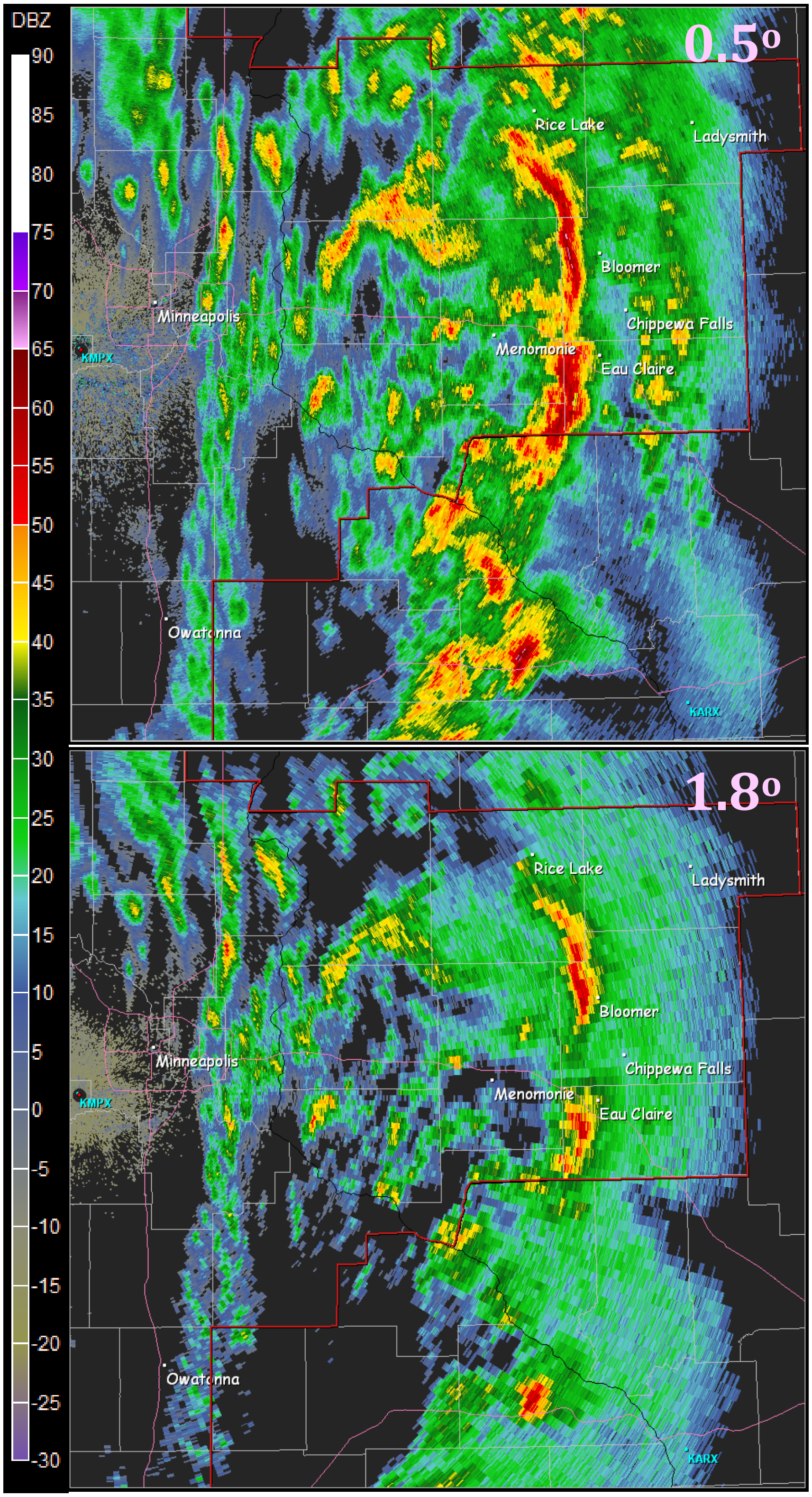

Figure 4: The 2-panel radar reflectivity image to the left is from May 24 2012 at 415pm. Again both images are from the same time. The top image is the reflectivity at 0.5º. Even though this is the lowest scan our radar is capable of, at this distance from the radar the center of the beam is over 9000ft above the ground! This is a good example of why timely spotter reports are very helpful for severe weather warnings.

The bottom image is reflectivity at 1.8º. Since the distance from the radar has increased, the 1.8º slice is still roughly 20,000ft above ground level. Notice how the two strong cells are just west of Bloomer and Eau Claire WI. This was just as the storms were causing damage along the county line.

As mentioned earlier, the environment that the storms formed within was conducive to severe weather. It is no surprise that wind damage occurred with this these storms. With that said, the signatures on radar were not straight-forward in indicating that 70 to 85 mph winds were occurring. One tool that meteorologists use to detect severe winds is *radar velocity*, which is different than *radar reflectivity*. The velocity measures the horizontal wind speeds within a storm that are towards or away from the radar. However, as storms move farther away from the radar, this becomes a less accurate estimation of the surface winds. In this case, the velocity data within the storm was poorly sampled by the radar (Fig 5).

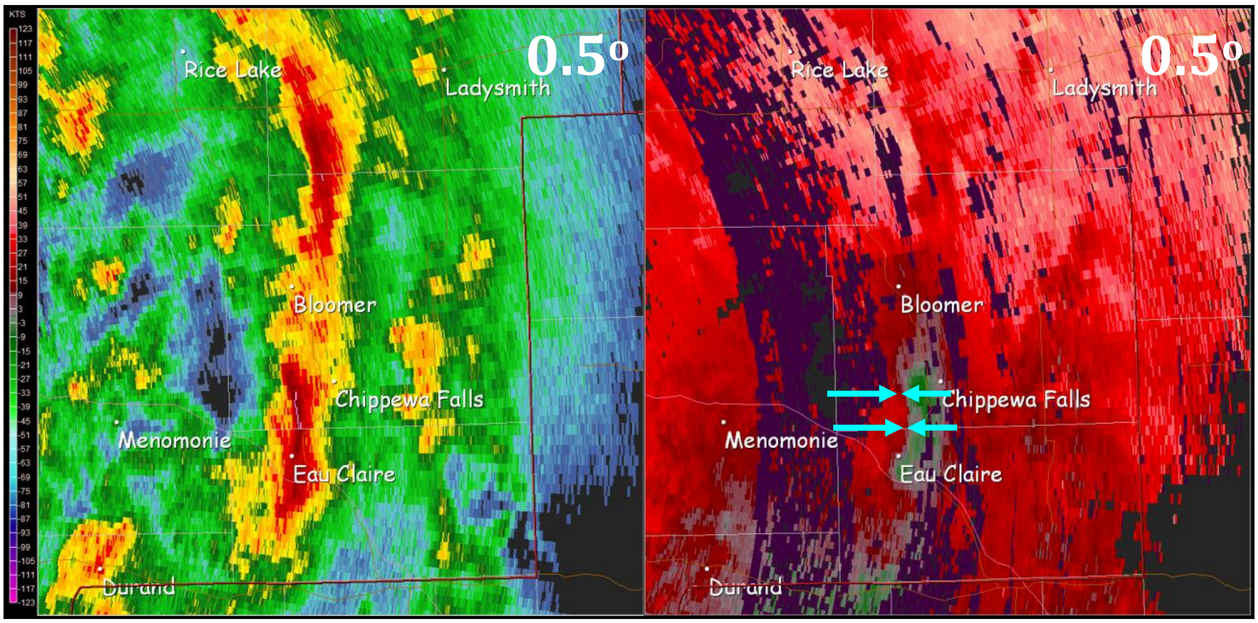

Figure 5: Two panel image of reflectivity (left) and velocity (right) at 430 pm on May 24 2012. At this time, the reflectivity shows the strongest storms are located over Eau Claire, and between Ladysmith and Rice Lake. Remember, the radar location is to the west. The red colors in the right-hand image show where the winds are moving away from the radar, and the green colors indicate where the winds are blowing towards the radar. The purple color is bad data, and cannot be used to assess severe thunderstorms. In this case, there was a weak MARC signature (Mid-Altitude Radial Convergence) just west of Chippewa Falls, as shown by the blue arrows. This convergent signature is one indication of strong winds.

Warning meteorologists often use surrounding radars to gather more information about severe thunderstorms. Radars best measure the winds within storms when they are either moving directly toward or away from the radar. The NWS office in La Crosse has a radar that is slightly closer to Eau Claire and Chippewa counties than the Minneapolis radar. In this case, because the storms were moving northeast, the La Crosse radar did not reveal any additional information, so it was of little help (Fig 6).

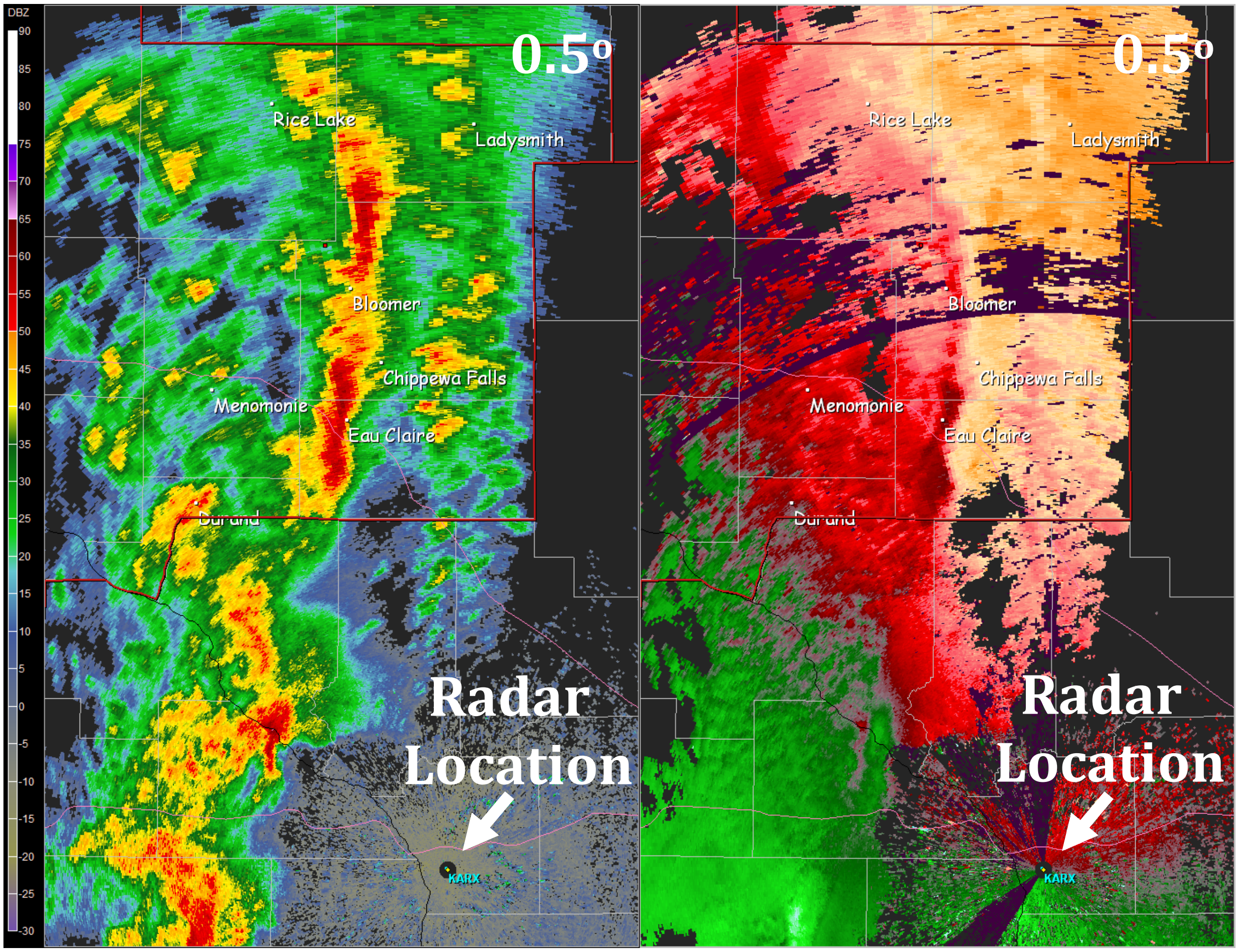

Figure 6: Two panel image of reflectivity (left) and velocity (right) at the 0.5° level at 428 pm on May 24 2012 from the La Crosse radar, which is located in the bottom of the image (white arrow). Since the radar location is to the south, red colors in the right-hand velocity image show where the winds are moving away from the radar, and the green colors indicate where the winds are blowing towards the radar. Again, the purple color is bad data, and cannot be used to assess severe thunderstorms. In this case, the storms were moving northeast and the La Crosse radar was of little use, although the tan colors just to the east of Eau Claire and Chippewa Falls indicate winds of 70 to 80 mph at 5000 to 8000 ft above ground level ahead of the storms.

The following page shows a few of the damage photos from the May 24th event. A special thanks to those who allowed us to use their pictures, and also to those who called in severe weather reports. That additional information helps to increase both the accuracy of the wording in the warning, and the confidence of the warning forecaster.

Figure 7: The images above show the large trees that were blown over by the straight-lined winds. A few structures were also destroyed. These images were relayed to us by the local Emergency Mangers.